PESTICIDE SURFACE WATER QUALITY REPORT

AUGUST 2000 SAMPLING EVENT

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Pesticide Monitoring Project Report
August 2000 Sampling Event

Executive Summary

As part of the District's quarterly ambient monitoring program, unfiltered water samples from 36 sites were collected from August 7 to August 9, 2000 and analyzed for over sixty pesticides and/or products of their degradation. The herbicides ametryn, atrazine, bromacil, hexazinone, metolachlor, norflurazon, and simazine, along with the insecticides/degradates atrazine desethyl, atrazine desisopropyl, diazinon, and ethion were detected in one or more of these surface water samples. The detected diazinon concentration (0.060 μg/L at S38B) should not have an acute, detrimental impact on fish. However, for aquatic invertebrates, this level is slightly greater than the calculated chronic toxicity (0.04 μg/L) for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. At this concentration, long term exposure can cause adverse effects on macroinvertebrate species, but the pulsed nature of urban and agricultural runoff releases to the canal system precludes drawing any conclusions about the effects of long term average exposures. The ethion concentrations of 0.030 and 0.032 μg/L at S99 and GORDYRD, respectively, approached the 48-hour EC_{50} of 0.06 μg/L reported for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. However, these concentrations did exceed the chronic toxicity level (0.003 μg/L) for *Daphnia magna* calculated according to promulgated procedure (FAC 62-302.200). At this level, long term exposure can cause adverse effects on macroinvertebrate species, but the pulsed nature of agricultural runoff releases to the canal system precludes drawing any conclusions about the effects of long term average exposures.

Background and Methods

The District's pesticide monitoring network includes stations designated in the Everglades National Park Memorandum of Agreement, the Miccosukee Tribe Memorandum of Agreement, the Lake Okeechobee Operating Permit, and the non-Everglades Construction Project (non-ECP) permit. The District's canals and marshes depicted in Figure 1 are protected as Class III (fishable and swimable) waters, while Lake Okeechobee is also protected as a Class I drinking water supply. Water Conservation Area 1 (WCA1) and the Everglades National Park are also designated as Outstanding Florida Waters to which anti-degradation standards apply. Surface water and sediment are sampled quarterly and semiannually, respectively, upstream at each structure identified in the permit.

Sixty-three pesticides and degradation products were analyzed for in samples from all of the 36 sites (Figure 1). The analytes, their respective minimum detection limits (MDL), and practical quantitation limits (PQL) are listed in Table 1. All the analytical work is performed by the Florida Department of Environmental Protection (FDEP) Central Laboratory in Tallahassee Florida. The reader is referred to the *Quality Assurance Evaluation* section of this report for a summary of any limitations on data validity that might influence the utility of these data.

Each pesticide's description and possible uses and sites of application are taken from Hartley and Kidd (1987). The Florida Ground Water Guidance Concentrations (FDEP, 1994) are listed to provide an indication at what level these pesticide residues could possibly impact human health, based on drinking water consumption or other routes of exposure (e.g., inhalation, ingestion of food residues, dermal uptake). Primary ground water standards are enforceable ground water standards, not screening tools or guidance levels. To evaluate the potential impacts on aquatic life, due to the pulsed nature of exposure, the maximum observed concentration is compared to the Criterion Maximum Concentration published by the USEPA under Section 304 (a) of the Clean Water Act, if available, or the lowest EC_{50} or LC_{50} reported in the summarized literature. This summary covers surface water samples collected between August 7 and August 9, 2000.

Findings and Recommendations

At least one pesticide was detected in the surface water at 34 of the 36 sites. The concentrations of the pesticides detected at each of the sites are summarized for the surface water in Table 2. All of these compounds have previously been detected in this monitoring program.

The ethion concentrations of 0.030 and 0.032 μg/L at S99 and GORDYRD, respectively, approached the 48-hour EC_{50} of 0.06 μg/L reported for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. However, these concentrations did exceed the chronic toxicity level (0.003 μg/L) for *Daphnia magna* calculated according to promulgated procedure (FAC 62-302.200). At this level, long term exposure can cause adverse effects on macroinvertebrate species, but the pulsed nature of agricultural runoff releases to the canal system precludes drawing any conclusions about the effects of long term average exposures. This is the first time ethion has been detected at the GORDYRD site. Since April 1996, eight out of eighteen sampling events at S99 had a detectable level of ethion in the surface water (Figure 2). With the method detection limit around 0.02 μg/L, any detection will automatically exceed the calculated chronic toxicity (0.003 μg/L) for *Daphnia magna*.

No endosulfan (α plus β) was detected in the surface water during this sampling event. The January 1996 and February 2000 sampling events at S178 were the last times the surface water concentrations exceeded the Florida Class III surface water quality standard (Chapter 62-302) (Figure 3).

The diazinon concentration detected (0.060 μg/L at S38B), should not have an acute, detrimental impact on fish. However, for aquatic invertebrates, this level is slightly greater than the calculated chronic toxicity (0.04 μg/L) for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. Since June 1998, four out of eleven events had a detectable level of diazinon, with all the values exceeding the chronic toxicity level for an aquatic invertebrate (*Daphnia magna*).

The above findings must be considered with the caveat that pesticide concentrations in surface water and sediment may vary significantly in relation to the timing and magnitude of pesticide application, rainfall events, pumping and other factors, and that this was only one sampling event. The possible long term or chronic toxicity impacts are also reported based on the single sampling event and do not take into account previous monitoring data.

Usage and Water Quality Impacts

Ametryn: Ametryn is a selective terrestrial herbicide registered for use on sugarcane, bananas, pineapple, citrus, corn, and non-crop areas. Most algal effects occur at concentrations > 10 μg/L (Verschueren, 1983). Environmental fate and toxicity data in Tables 3 and 4 indicate that ametryn (1) is lost from soil relatively easily by leaching, surface adsorption, and in surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data includes a 96 hour LC_{50} of 14.1 mg/L for goldfish (Hartley and Kidd, 1987). The ametryn surface water concentrations found in this sampling event ranged from 0.012 to 0.27 μg/L. Using these criteria, these surface water levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Atrazine: Atrazine is a selective systemic herbicide registered for use on pineapple, sugarcane, corn, rangelands, ornamental turf and lawn grasses, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that atrazine (1) is easily lost from soil by leaching and in surface solution, with moderate loss from surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96 hour LC_{50} of 76 mg/L for carp, 16 mg/L for perch and 4.3 mg/L for guppies (Hartley and Kidd, 1987). Also, in a flow-through bioassay, the maximum acceptable toxicant concentration (MATC) of atrazine was 90 and 210 μg/L for bluegill and fathead minnow (Verschueren, 1983). Atrazine inhibits cell multiplication of the alga, *Microcystis aeruginosa*, at 3 μg/L and most other biological effects occur at higher concentrations (Verschueren, 1983). The atrazine surface water concentrations found in this sampling event at 33 of the 36 sampling locations, ranged from 0.021 to 1.5 μg/L. Using these criteria, these levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Atrazine desethyl (DEA) and atrazine desisopropyl (DIA) are biotic degradation products of atrazine. These degradation products are both persistent and mobile in water; however, DEA is more stable and the dominant initial metabolite. Since DEA and DIA are structurally and toxicologically similar to atrazine, the concentrations of total atrazine residue (atrazine + DEA + DIA) may also be a significant consideration in the surface water environment. The DEA to atrazine ratio, on a molar basis, (DAR) has been suggested as an indicator of nonpoint-source pollution of groundwater (Adams and Thurman, 1991) and as a tracer of ground water discharge into rivers (Thurman et al., 1992). Goolsby et al. (1997) determined that low DAR values, median <0.1, occur in streams during runoff shortly after application of atrazine. Higher DAR values, median about 0.4, occur later in the year after considerable degradation of atrazine to DEA has occurred in the soil. The low median DAR ratio (0.1) at the locations where both atrazine and DEA were detected, suggests minimum degradation of atrazine (Table 5). No appreciable difference can be detected when the DAR is determined on the basis of flow or no flow (Table 5). However, these general guidelines were developed based on observations in Midwest watersheds in northern temperate climates with different soil and water management regimes as well as higher atrazine water concentrations. Applications to the south Florida environment should be made with caution.

Bromacil: Bromacil is a terrestrial herbicide registered for use on pineapple, citrus, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that bromacil (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data includes a 96 hour LC_{50} of 164 mg/L for carp (Hartley and Kidd, 1987). The highest concentration of bromacil detected in the surface water during this sampling event was at CR33.5T (3.6 µg/L). Using these criteria, these levels should not have an acute or chronic detrimental impact on fish.

Diazinon: Diazinon is a non-systemic insecticide and acaricide registered for use on a wide range of crops including citrus, bananas, vegetables, potatoes, sugarcane, rice and ornamentals. Environmental fate and toxicity data in Tables 3 and 4 indicate that diazinon (1) is easily lost from soil by surface solution, with a moderate loss from leaching, and minimum loss from surface adsorption; (2) is slightly toxic to mammals and relatively toxic to fish; and (3) does not bioaccumulate significantly. The diazinon concentration detected (0.060 µg/L at S38B), should not have an acute, detrimental impact on fish. However, for aquatic invertebrates, this level is slightly greater than the calculated chronic toxicity (0.04 µg/L) for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. Since June 1998, four out of eleven events had a detectable level of diazinon, with all the values exceeding the toxicity level for an aquatic invertebrate (*Daphnia magna*). At this concentration, long term exposure can cause impacts to the macroinvertebrate populations.

Ethion: Ethion is a non-systemic acaricide and insecticide registered for use on several fruits, citrus, and vegetables. Environmental fate and toxicity data in Tables 3 and 4 indicate that ethion (1) is strongly sorbed to soil and therefore can accumulate in sediments; (2) is slightly toxic to mammals, relatively toxic to fish and extremely toxic to Daphnia; and (3) bioconcentrates to a limited extent. Several sources of toxicity information have shown both agreement and disagreement of these laboratory tests. The ethion concentrations of 0.030 and 0.032 µg/L at S99 and GORDYRD, respectively, approached the 48-hour EC_{50} of 0.06 µg/L reported for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. However, these concentrations did exceed the chronic toxicity level (0.003 µg/L) for *Daphnia magna* calculated according to promulgated procedure (FAC 62-302.200). At this level, long term exposure can cause impacts to macroinvertebrate populations, but the pulsed nature of agricultural runoff releases to the canal system precludes drawing any conclusions about the effects of long term average exposures. This is the first time ethion has been detected at the GORDYRD site. Since April 1996, eight out of eighteen sampling events at S99 had a detectable level of ethion in the surface water (Figure 2). With the method detection limit around 0.019 µg/L, any detection will automatically exceed the calculated chronic toxicity (0.003 µg/L) for *Daphnia magna*.

Hexazinone: Hexazinone is a non-selective contact herbicide that inhibits photosynthesis. Registered uses include sugarcane, pineapple, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that hexazinone (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Hexazinone is practically non-toxic to freshwater invertebrates with an EC_{50} of 145 mg/l for *Daphnia magna* (U.S. Environmental Protection Agency, 1988). The surface water concentrations found in this sampling event ranged from 0.021 to 0.34 μg/L (Table 2). Using these criteria, these levels should not have a harmful impact on fish or aquatic invertebrates.

Metolachlor: Metolachlor is a selective herbicide used on potatoes, sugarcane, and some vegetables. Environmental fate and toxicity data in Tables 3 and 4 indicate that metolachlor (1) has a large potential for loss due to leaching and a medium potential for loss in surface solution and due to surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Metolachlor is non-toxic to birds (Lyman et al., 1990). The surface water concentrations found in this sampling event ranged from 0.012 to 1.2 μg/L (Table 2). This is two orders of magnitude below the calculated chronic action level. Using these criteria, these levels should not have a harmful impact on fish or aquatic invertebrates.

Norflurazon: Norflurazon is a selective herbicide registered for use on many crops including citrus. Environmental fate and toxicity data in Tables 3 and 4 indicate that norflurazon (1) is easily lost from soil surface solution and a moderate potential for loss due to leaching and surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. The LC_{50} for norflurazon is >200 mg/L for catfish and goldfish (Hartley and Kidd, 1987). The norflurazon surface water concentrations ranged from 0.039 to 1.8 μg/L. Even at the highest concentration, this is two orders of magnitude below the calculated chronic action level. Using these criteria, these levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Simazine: Simazine is a selective systemic herbicide registered for use on many crops including sugarcane, citrus, corn, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that simazine (1) is easily lost from soil by leaching and has a moderate potential for loss due to surface adsorption and surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96 hour LC_{50} of 49 mg/L for guppies (Hartley and Kidd, 1987). Most of the aquatic biological effects occur at concentrations > 500 μg/L (Verschueren, 1983). Aquatic invertebrate LC_{50} toxicity ranges from 3.2 mg/L to 100 mg/L for simazine (U.S. Environmental Protection Agency, 1984). The highest surface water concentration of simazine was detected at CR33.5T (0.51 μg/L), below any level of concern for fish or aquatic invertebrates.

Quality Assurance Evaluation

Four duplicate samples were collected at sites S18C, S65E, G123, S78, and S190. All the analytes detected in the surface water had precision $\leq$30% RPD. No analytes were detected in the field blanks collected at S12C, S7, and S2. All samples were shipped and all bottles were received.

Low concentrations of representative analytes from each pesticide group/method were added to laboratory water as well as to samples submitted. All analytes for each sample adhered to the targets for precision and accuracy as outlined in the FDEP Comprehensive Quality Assurance Plan. Organic quality assurance targets are set according to historically generated data or are adapted from the U.S. Environmental Protection Agency with slight modifications or internal goals, based on FDEP limited data. Parameters with low or high recoveries indicate that the sample matrix interferes with these analyses and interpretation of the respective analytical results should consider this effect.

Glossary

LD_{50}: The dosage which is lethal to 50% of the terrestrial animals tested within a short (acute) exposure period, usually 24 to 96 hours.

LC_{50}: A concentration which is lethal to 50% of the aquatic animals tested within a short (acute) exposure period, usually 24 to 96 hours.

EC_{50}: A concentration necessary for 50% of the aquatic species tested to exhibit a toxic effect short of mortality (e.g., swimming on side or upside down, cessation of swimming) within a short (acute) exposure period, usually 24 to 96 hours.

Koc: The soil/sediment partition or sorption coefficient normalized to the fraction of organic carbon in the soil. This value provides an indication of the chemical's tendency to partition between soil organic carbon and water.

Bioconcentration Factor:
The ratio of the concentration of a contaminant in an aquatic organism to the concentration in water, after a specified period of exposure via water only. The duration of exposure should be sufficient to achieve a near steady-state condition.

Soil or water half-life:
The time required for one-half the concentration of the compound to be lost from the water or soil under the conditions of the test.

MDL: The minimum concentration of an analyte that can be detected with 99% confidence of its presence in the sample matrix.

PQL: The lowest level of quantitation that can be reliably achieved within specified limit of precision and accuracy during routine laboratory operating conditions. The PQL is further verified by analyzing spike concentrations whose relative standard deviation in 20 fortified water samples is < 15%. In general, the PQL is 2 to 5 times larger than the MDL.

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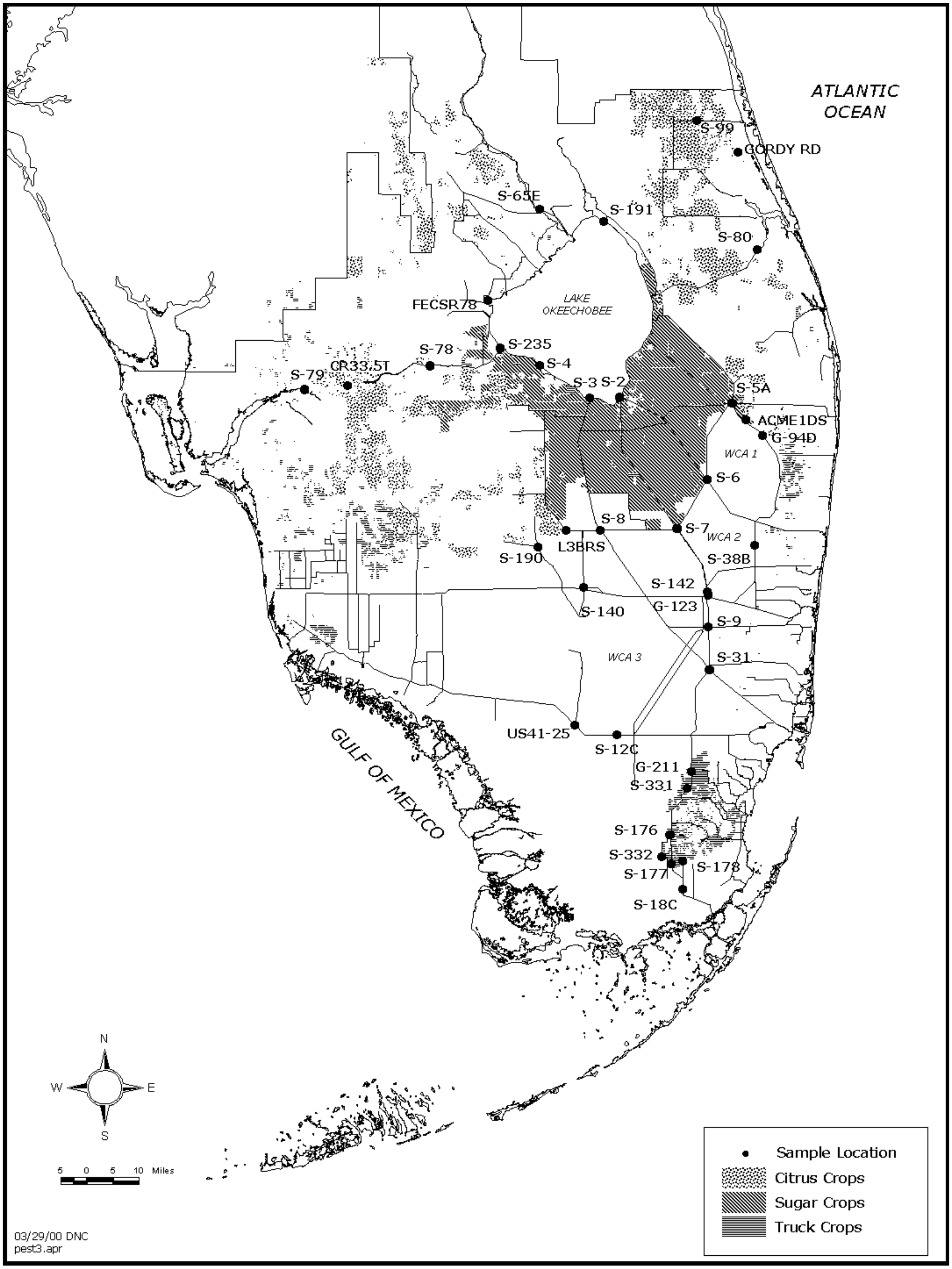

Figure 1. SFWMD Pesticide Monitoring Network

Table 1. Minimum detection limits (MDL) and practical quantitation limits (PQL) for pesticides determined in August 2000.

Pesticide or metabolite	Water range of MDL-PQL (μg/L)	Pesticide or metabolite	Water range of MDL-PQL (μg/L)
2,4-D	0.8 - 1.6	α-endosulfan (alpha)	0.0019 - 0.0096
2,4,5-T	0.8 - 1.6	β-endosulfan (beta)	0.0019 - 0.0096
2,4,5-TP (silvex)	0.8 - 1.6	endosulfan sulfate	0.0019 - 0.0095
alachlor	0.048 - 0.24	endrin	0.0019 - 0.0095
aldrin	0.00095 - 0.0048	endrin aldehyde	0.0019 - 0. 0095
ametryn	0.0095 - 0.048	ethion	0.019 - 0.095
atrazine	0.0095 - 0.048	ethoprop	0.019 - 0.095
atrazine desethyl	0.0095 - 0.048	fenamiphos (nemacur)	0.029 - 0.14
atrazine desisopropyl	0.0095 - 0.048	fonofos (dyfonate)	0.019 - 0.096
azinphos methyl (guthion)	0.019 - 0.096	heptachlor	0.00095 - 0.0048
α-BHC (alpha)	0.00095 - 0.0048	heptachlor epoxide	0.00095 - 0.0096
β-BHC (beta)	0.0019 - 0.0096	hexazinone	0.019 - 0.096
δ-BHC (delta)	0.00095 - 0.0048	imidacloprid	0.2 - 0.4
γ-BHC (gamma) (lindane)	0.00095 - 0.0048	linuron	0.2 - 0.4
bromacil	0.038 - 0.19	malathion	0.029 - 0.14
butylate	0.019 - 0.096	metalaxyl	0.048 - 0.19
carbophenothion (trithion)	0.029 - 0.029	methoxychlor	0.0038 - 0.038
chlordane	0.0095 - 0.096	metolachlor	0.057 - 0.3
chlorothalonil	0.019 - 0.019	metribuzin	0.019 - 0.096
chlorpyrifos ethyl	0.019 - 0.096	mevinphos	0.076 - 0.19
chlorpyrifos methyl	0.0095 - 0.048	mirex	0.0019 - 0.0096
cypermethrin	0.0048 - 0.048	naled	0.076 - 0.38
DDD-p,p’	0.0019 - 0.0096	norflurazon	0.019 - 0.096
DDE-p,p’	0.0019 - 0.0096	parathion ethyl	0.019 - 0.096
DDT-p,p’	0.0019 - 0.0096	parathion methyl	0.019 - 0.096
demeton	0.11 - 0.48	PCB	0.019 - 0.096
diazinon	0.019 - 0.096	permethrin	0.048 - 0.019
dicofol (kelthane)	0.019 - 0.038	phorate	0.029 - 0.14
dieldrin	0.0019 - 0.0048	prometryn	0.019 - 0.096
disulfoton	0.019 - 0.096	simazine	0.0095 - 0.048
diuron	0.2 - 0.4	toxaphene	0.071 - 0.29
		trifluralin	0.0095 - 0.0096

Table 2. Summary of pesticide residues above the method detection limit found in surface water samples collected by SFWMD in August 2000.

DATE	SITE	FLOW	COMPOUNDS (µg/L)											Number of compounds detected at site
			ametryn	atrazine	atrazine desethyl	atrazine desisopropyl	bromacil	diazinon	ethion	hexazinone	metolachlor	norflurazon	simazine	
8/07/00	S18C	Y	-	0.022 I*	-	-	-	-	-	-	-	-	-	1
	S178	N	-	0.025 I	-	-	-	-	-	-	-	-	-	1
	S177	Y	-	0.024 I	-	-	-	-	-	-	-	-	-	1
	S332	N	-	0.024 I	-	-	-	-	-	-	-	-	-	1
	S176	Y	-	0.027 I	-	-	-	-	-	-	-	-	-	1
	S331	Y	-	0.021 I	-	-	-	-	-	-	-	-	-	1
	G211	Y	-	-	-	-	-	-	-	-	-	-	-	0
8/08/00	US41-25	Y	-	-	-	-	-	-	-	-	0.012 I	-	-	1
	S12C	N	0.013 I	0.11	0.012 I	-	-	-	-	-	-	-	-	3
	S31	N	-	0.040 I	-	-	-	-	-	-	-	-	-	1
	S9	Y	-	0.15	0.015 I	-	-	-	-	-	-	-	-	2
	G123	N	-	0.069 *	-	-	-	-	-	-	-	-	-	1
	S142	N	0.020 I	0.064	0.010 I	-	-	-	-	-	-	-	-	3
	S140	Y	-	-	-	-	0.19 I	-	-	0.34	-	0.079 I	-	3
	S38B	N	0.012 I	1.5	0.14	-	-	0.060 I	-	-	-	-	-	4
	S99	Y	-	-	-	0.027 I	0.44	-	0.030 I	-	-	1.1	0.42	5
	GORDYRD	Y	-	-	-	0.031 I	0.81	-	0.032 I	-	0.090 I	1.8	0.31	6
	S80	N	-	-	-	0.011 I	-	-	-	-	-	0.46	0.45	3
	S191	N	-	-		-	0.048 I	-	-	-	-	0.039 I	0.050	3
	S65E	Y	-	0.035 *I	-	-	0.065 *I	-	-	-	-	-	0.034 *I	3
	FECSR78	Y	-	-	-	-	-	-	-	-	-	-	-	0
8/09/00	S190	N	-	0.15 *	0.028 *I	-	0.45 *	-	-	-	-	0.088 *I	-	4
	L3BRS	N	0.025 I	0.10	0.020 I	-	-	-	-	-	-	-	-	3
	S8	Y	-	0.14	0.017 I	-	-	-	-	-	-	-	-	2
	S7	Y	0.049	0.11	0.016 I	-	-	-	-	-	-	-	-	3
	S6	Y	0.078	0.082	0.011 I	-	-	-	-	0.032 I	-	-	-	4
	G94D	N	0.040 I	0.15	0.014 I	-	-	-	-	0.045 I	-	-	-	4
	ACME1DS	N	-	0.18	0.017 I	-	-	-	-	0.065 I	-	-	-	3
	S5A	Y	-	-	-	-	0.048 I	-	-	-	-	-	-	1
	S79	N	0.019 I	0.22	0.022 I	0.015 I	1.2	-	-	-	0.13 I	0.36	0.17	8
	CR33.5T	Y	-	1.1	0.044 I	0.041 I	3.6	-	-	-	1.2	0.84	0.51	7
	S78	N	-	-	0.021 *I	0.011 *I	-	-	-	0.025 *I	-	0.33 *	0.044 *I	5
	S235	N	0.058	0.25	0.032 I	0.035 I	1.1	-	-	-	-	0.23	0.45	7
	S4	N	0.13	0.090	-	-	-	-	-	0.021 I	-	-	-	3
	S3	N	0.041 I	0.074	0.010 I	-	-	-	-	-	-	-	-	3
	S2	N	0.27	0.078	0.012 I	-	-	-	-	-	-	-	-	3
Total number of compound detections			12	26	17	7	10	1	2	6	4	10	9	

N – no Y – yes R – reverse ; - denotes that the result is below the MDL; * - results are the average of duplicate samples; I - value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit

Table 3. Selected properties of pesticides found in the August 2000 sampling event.

Common name	FDEP Surface Water Standards 62-302 (µg/L)	Florida Ground Water Guidance Conc. (µg/L)	LD_{50} acute rats oral (mg/Kg) (1)	EPA carcinogenic potential	Water Solubility (mg/L) (2, 3)	Koc (ml/g) (2, 3)	soil half-life (days) (2, 3)	SCS rating (2) LE	SA	SS	Bioconcentration Factor (BCF)
ametryn	-	63	1,110	D	185	300	60	M	M	M	33
atrazine	-	3**	3,080	C	33	100	60	L	M	L	86
bromacil	-	90	5,200	C	700	32	60	L	M	M	15
diazinon	-	0.6	240 - 480	E	40	570	40	M	S	L	77
ethion	-	3.5	208	-	1.1	8900	150	S	L	M	586
hexazinone	-	231	1,690	D	33,000	54	90	L	M	M	2
metolachlor	-	1050	2,780	C	530	200	90	L	M	M	18
norflurazon	-	280	9,400	C	28	700	90	M	M	L	94
simazine	-	4**	>5,000	C	6.2	130	60	L	M	M	221

SCS Ratings are pesticide loss due to leaching (LE), surface adsorption (SA) or surface solution (SS) and grouped as large (L), medium (M), small (S) or extra small (XS)
Bioconcentration Factor (BCF) calculated as BCF = 10^(2.791 - 0.564 log WS) (4)
B2: probable human carcinogen; C: possible human carcinogen; D: not classified; E: evidence of non-carcinogen for humans (5)
FDEP surface water standards (12/96) for Class III water except Class I in ( )
**primary standard

(1) Hartley, D. and H. Kidd. (Eds.) (1987). The Agrochemicals Handbook. Second Edition, The Royal Society of Chemistry. Nottingham, England.
(2) Goss, D. and R. Wauchope. (Eds.) (1992). The SCS/ARS/CES Pesticide Properties Database: II Using It With Soils Data In A Screening Procedure. Soil Conservation Service. Fort Worth, TX.
(3) Montgomery, J.H. (1993). Agrochemicals Desk Reference: Environmental Data. Lewis Publishers. Chelsa, MI.
(4) Lyman,W.J., W.F. Reehl, and D.H. Rosenblatt. (1990). Handbook of Chemical Property Estimation Methods. American Chemical Society, Washington, DC.
(5) U.S. Environmental Protection Agency (1996). Drinking Water Regulations and Health Advisories. Office of Water. EPA 822-B-96-002.

Table 4. Toxicity of pesticides found in the August 2000 sampling event to selected freshwater aquatic invertebrates and fishes (ug/L).

Common name	48 hr EC_{50} Water flea *Daphnia Magna*		acute toxicity (*)	chronic toxicity (*)	96 hr LC_{50} Fathead Minnow (#) *Pimephales Promelas*		acute toxicity	chronic toxicity	96 hr LC_{50} Bluegill *Lepomis macrochirus*		acute toxicity	chronic toxicity	96 hr LC_{50} Largemouth Bass *Micropterus salmoides*		acute toxicity	chronic toxicity	96 hr LC_{50} Rainbow Trout (#) *Oncorhynchus mykiss*		acute toxicity	chronic toxicity	96 hr LC_{50} Channel Catfish *Ictalurus punctatus*		acute toxicity	chronic toxicity
ametryn	28,000	(6)	9,333	1,400	-		-	-	4,100	(4)	1,367	205	-		-	-	8,800	(4)	2,933	440	-		-	-
atrazine	6,900	(6)	2,300	345	15,000	(6)	5,000	750	16,000	(4)	5,333	800	-		-	-	8,800	(4)	2,933	440	7,600	(4)	2,533	380
bromacil	-		-	-	-		-	-	127,000	(6)	42,333	6,350	-		-	-	36,000	(6)	12,000	1,800	-		-	-
diazinon	0.8	(1)	0.3	0.04	7,800	(6)	2,600	390	168	(1)	56	8.4	-		-	-	90	(1)	30	4.5	-		-	-
	0.9	(8)	0.3	0.045	-		-	-	165	(3)	55	8.3	-		-	-	1,650	(3)	550	83	-		-	-
	-		-	-	-		-	-	16,000	(4)	5,333	800	-		-	-	2,900	(4)	967	145	-		-	-
ethion	0.06	(1)	0.02	0.003	720	(1)	240	36	210	(1)	70	11	173	(1)	58	9	500	(1)	167	25	7600	(1)	2533	380
	-		-	-	-		-	-	13	(3)	4.3	0.65	150	(8)	50	8	193	(3)	64	10	7500	(8)	2500	375
	-		-	-	-		-	-	22	(8)	7.3	1.1	-		-	-	560	(8)	187	28	-		-	-
hexazinone	151,600	(6)	50,533	7,580	274,000	(4)	91,333	13,700	100,000	(6)	33,333	5,000	-		-	-	180,000	(6)	60,000	9,000	-		-	-
metolachlor	23,500	(6)	7,833	1,175	-		-	-	15,000	(4)	5,000	750	-		-	-	2,000	(4)	667	100	4,900	(5)	1,633	245
norflurazon	15,000	(6)	5,000	750	-		-	-	16,300	(6)	5,433	815	-		-	-	8,100	(6)	2,700	405	>200,000	(4)	>67,000	>10,000
simazine	1,100	(6)	367	55	100,000	(6)	33,333	5,000	90,000	(4)	30,000	4,500	-		-	-	100,000	(6)	33,333	5,000	-		-	-

*) Florida Administrative Code (FAC) 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community.

(#) Species is not indigenous. Information is given for comparison purposes only.

(1) Johnson, W. W. and M.T. Finley (1980). Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. U.S. Department of the Interior, Fish and Wildlife Service Resource Publication 137. Washington, DC.

(2) U.S. Environmental Protection Agency (1977). Silvacultural Chemicals and Protection of Water Quality. Seattle, WA. EPA-910/9-77-036.

(3) Schneider, B.A. (Ed.) (1979). Toxicology Handbook, Mammalian and Aquatic Data, Book 1: Toxicology Data. U.S. Environmental Protection Agency. U.S. Government Printing Office. Washington, DC. EPA-5400/9-79-003

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(6) U.S. Environmental Protection Agency (1991) Pesticide Ecological Effects Database, Ecological Effects Branch, Office of Pesticide Programs, Washington, D.C.

(7) Verschueren, K. (1983). Handbook of Environmental Data on Organic Chemicals. Second Edition, Van Nostrand Reinhold Co. Inc., New York N.Y.

(8) U.S. Environmental Protection Agency (1972). Effects of Pesticides in Water: A Report to the States. U.S. Government Printing Office. Washington, D.C.

(9) Mayer, F.L., and M.R. Ellersieck. (1986). Manual of Acute Toxicity: Interpretation and Database for 410 Chemicals and 66 Species of Freshwater Animals. U.S. Fish and Wildlife Service, Publication No. 160

Table 5. Atrazine Desethyl/Atrazine ratio (DAR) Data.

DATE	SITE	FLOW*	atrazine ug/L	moles/L	atrazine desethyl ug/L	moles/L	DAR
8/8/00	S12C	Y	0.11	5.1E-10	0.012	6.4E-11	0.1
	S9	Y	0.15	7.0E-10	0.015	8.0E-11	0.1
	S142	Y	0.064	3.0E-10	0.010	5.3E-11	0.2
	S38B	N	1.5	7.0E-09	0.14	7.5E-10	0.1
8/9/00	S190**	N	0.15	7.0E-10	0.028	1.5E-10	0.2
	L3BRS	N	0.10	4.6E-10	0.020	1.1E-10	0.2
	S8	Y	0.14	6.5E-10	0.017	9.1E-11	0.1
	S7	Y	0.11	5.1E-10	0.016	8.5E-11	0.2
	S6	Y	0.082	3.8E-10	0.011	5.9E-11	0.2
	G94D	Y	0.15	7.0E-10	0.014	7.5E-11	0.1
	ACMEIDS	Y	0.18	8.3E-10	0.017	9.1E-11	0.1
	S79	N	0.22	1.0E-09	0.022	1.2E-10	0.1
	CR33.5T	Y	1.1	5.1E-09	0.044	2.3E-10	0.0
	S235	N	0.25	1.2E-09	0.032	1.7E-10	0.1
	S3	N	0.074	3.4E-10	0.010	5.3E-11	0.2
	S2	N	0.078	3.6E-10	0.012	6.4E-11	0.2

DAR	all sites	flow only sites	no flow sites
average	0.1	0.1	0.2
median	0.1	0.1	0.2
minimum	0.0	0.0	0.1
maximum	0.2	0.2	0.2

**Average * N – no; Y – yes

Figure 2. Ethion Concentration in Surface Water at S99

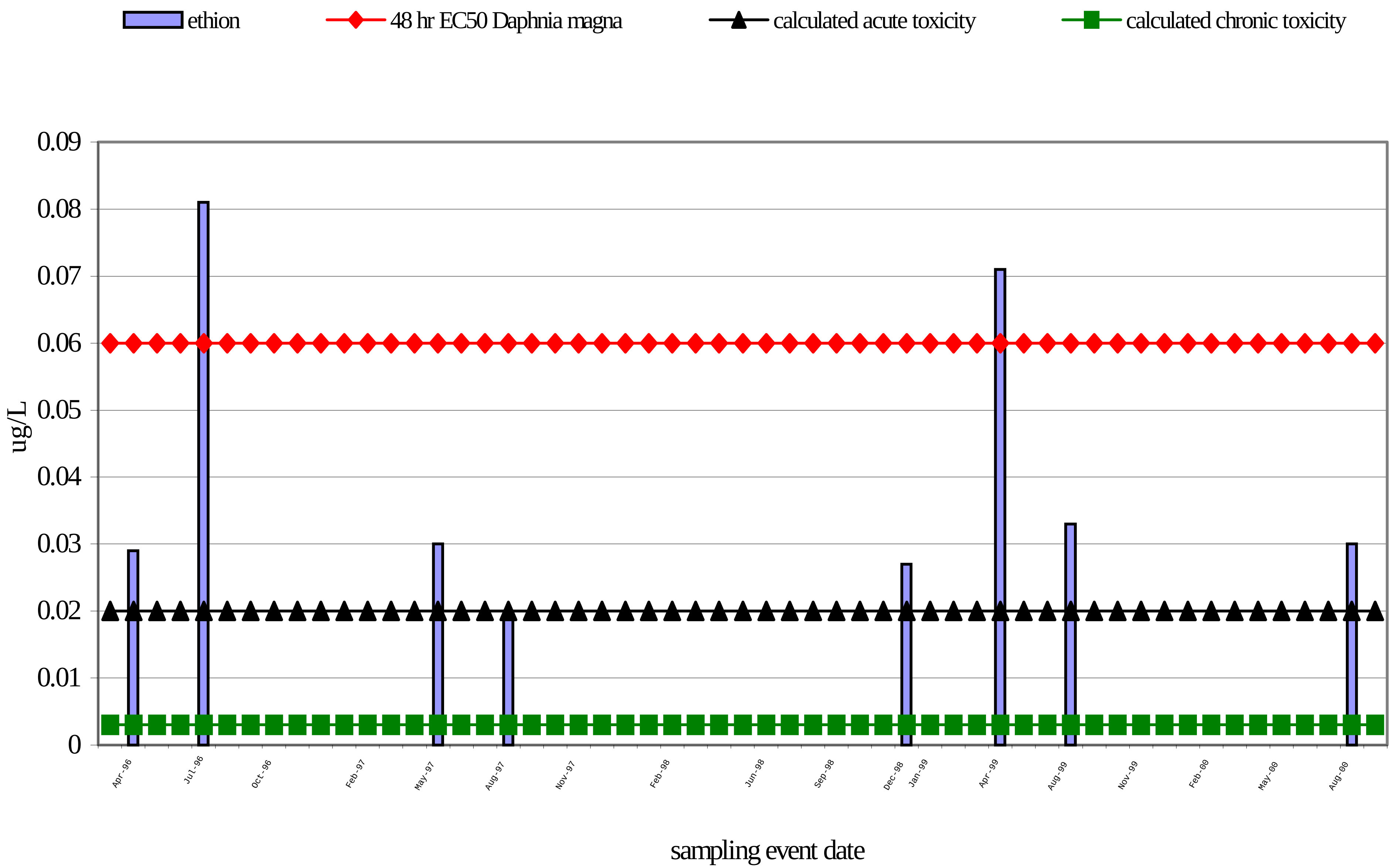

Figure 3. Endosulfan Concentration in Surface Water at S178